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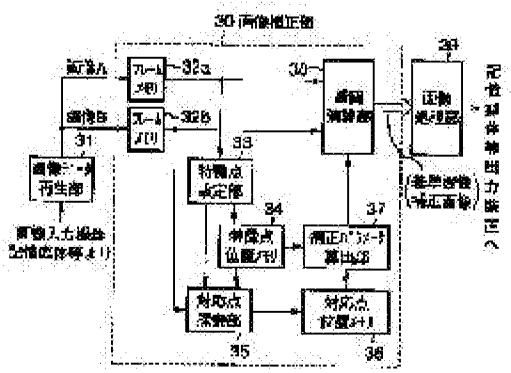
(54) IMAGE PROCESSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To exactly overlap images by correcting the images so as to match the object positions of the respective images based on the feature position information of input images and the deviation between the respective coordinates of position information at correspondent points.

SOLUTION: A feature point setting part 33 sets the plural feature points (coordinates) of the input image. Image data around the feature points are segmented as a template and inputted to a correspondent point search part 35. The correspondent point search part 35 searches a point corresponding to the template in an image different from the image inputted to the feature point setting part 33 and outputs the correspondent point coordinate position to a correspondent point position memory 36. A correction parameter calculating part 37 reads out the feature point coordinate in a memory 34 and the correspondent point coordinate in a memory 36 and calculates the position relation (parallel moving amount or rotating angle) between two images. An interpolation operating part 38 corrects the images based on the inputted position relation and outputs them to an image synthesizing part 39. The image synthesizing part 39 executes dynamic range expanding processing or object field depth expanding processing.



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CLAIMS

[Claim(s)]
[Claim 1]An image processing device which performs alignment processing between two or more pictures which photoed almost same composition by a different photographing condition, comprising:
A seek-area setting-out means to divide at least one picture of an inputted picture into two or more region divisions, and to provide a seek area showing the feature of a picture of the focus in said each region division.
The 1st position information extraction means that relates characteristic position information on a photographic subject within said composition to coordinates over each region division of said division picture, and extracts it from a seek area of each of said focus based on characteristic quantity of said picture.
The 2nd position information extraction means extracted as position information which related a point acquired by searching for a point corresponding to said characteristic position information to each of said inputted images other than said divided picture of corresponding to coordinates over the picture.
A corrected parameter detection means to detect a corrected parameter based on a gap between each coordinates of said extracted characteristic position information and position information on said point of corresponding, and a picture compensation means which amends a picture based on a detected corrected parameter so that an object position of each picture may be in agreement.

[Claim 2]The image processing device according to claim 1, wherein position information extracted by the said 1st and 2nd position information extraction means is the position information which excepted position information relevant to coordinates of a region division where an object which moves in inside of said picture was detected.

[Claim 3]Position information extracted by the said 1st and 2nd position information extraction means, a pixel with which a high frequency component when orthogonal transformation was carried out was comparatively saturated to each region division within said picture -- comparatively on the basis of a value of a difference of average value of a pixel value, and the greatest and minimum pixel value, and either of the contrast. The image processing device according to claim 2 extracting coordinates related position information over a desired region division from said inputted picture.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the image processing device which performs alignment amendment so that a photographic subject may be in agreement, when the device which combines the picture beyond the dynamic range and depth of field of the input device is started from two or more pictures which photoed the same photographic subject by a different photographing condition, especially each picture is piled up.
[0002]
[Description of the Prior Art]By combining two or more pictures which generally photoed the same photographic subject by different exposure. The image processing technique which creates the picture which has a dynamic range of the range more than the peculiar dynamic range of image sensors, such as CCD (Charge Coupled Device). (For example, JP,63-232591,A) Two or more pictures which photoed the same photographic subject in a different focal position are combined, and there is an image processing technique (JP,1-309478,A) which creates the picture which has depth of field deeper than the depth of field of an input optical system.
[0003]Art which creates this wide dynamic range image is realized with the composition shown in drawing 12 (a). Picture illustrated. A and B are the pictures which changed and photoed exposure, respectively.
The relation between the incident light quantity which enters into an image sensor, and the signal value of the picture acquired with image input apparatus becomes like "[A] long time exposure" of drawing 12 (b), and "[B] short-time exposure."

[0004]In the adding machine 11, the pixel value of the pictures A and B is added and the value shown in drawing 12 (b) as a "[C] summed signal" is memorized by the frame memory 12. The

shape of this "[C] Summed signal" is determined by the exposure ratio of the picture of two sheets. In the linear transform part 13, the incident light quantity I is presumed from the summed signal value S, and it changes into the luminance-signal value Y from the signal value of R, B, and G each color in the matrix circuit 15.

[0005]And in the luminosity compression zone 16, a luminance value is compressed and compressed luminance-signal value Y' is outputted so that presumed incident light quantity may be settled in a fixed gradation number. R, G, and B which Y'/Y is calculated in the divider 17 and are the outputs of the linear transform part 16 -- it is multiplied with each signal and multiplier 18, and a result is stored in the frame memory 19.

[0006]Since this image processing technique uses two or more image data, it can acquire the picture which has good color reproduction, and few noises compared with the case where tone curve processing of the short-time exposure picture is only carried out.

[0007]The image processing technique which creates the picture which has depth of field deeper than the depth of field of the input optical system mentioned above is realized with the composition shown, for example in drawing 13. First, weighting addition is carried out with the adding machine 21, and the picture which changed the focal position and was photoed is memorized by the frame memory 22. If weighting addition of the picture which changed the focal position is carried out according to a focal position, it is known that the Japanese quince of the whole picture will be equalized.

[0008]So, in the recovery filter setting circuit 25, the recovery filter of the Japanese quince in the picture after addition is determined, and it outputs to the matrix arithmetic circuit 23. Here, since it is not a portion in connection with the essence of this invention, the preparation method of a Japanese quince recovery filter is omitted. In the matrix arithmetic circuit 23, a recovery filter is made to act on an addition picture, and a result is stored in the frame memory 24. As a result, the picture stored in the frame memory 24 is a picture whose depth of field is deeper than an imaging optical system.

[0009]

[Problem(s) to be Solved by the Invention]Once the image processing technique mentioned above adds or adds [weighting] the photoed picture for every pixel, it performs dynamic-range-compression processing and a series of processings of recovery. Therefore, when the picture which is the target of addition had caused the position gap mutually, it shifted, when it added and an exact result was not obtained.

[0010]Therefore, in the case of dynamic range expanding processing, . Since nondestructive readout is possible, use the apparatus using the CMD (Charge Modurated Device) element which does not cause a position gap while photoing a picture by two or more exposure theoretically. In depth-of-field expanding processing, as it said that a firm stage was required, the expensive business-use device was needed. When changing and photoing a focal position,

change of the delicate magnification for every focal position also influences.

[0011]With a digital camera, a scanner, and a tripod which a general user uses, what [a thing] that cannot expect accuracy simple occupies most to it compared with commercial equipment. Therefore, the advantage of the image processing technique mentioned above was not fully able to be employed efficiently.

[0012]For example, when a camera moves when carrying and photoing a digital camera to a tripod, and pushing a shutter, or capturing the image photoed with the film-based camera by a film scanner, it is shifting mutually by the method of insertion of a film etc.

[0013]Then, an object of this invention is to provide the image processing device amended with the value of the parameter which detects the physical relationship between several pictures from which photographing conditions, such as exposure and a focal position, differ, and shows the detected physical relationship so that a picture may lap correctly.

[0014]

[Means for Solving the Problem]An image processing device whose this invention is characterized by that an image processing device comprises the following and which performs alignment processing between two or more pictures which photoed to achieve the above objects almost same composition (photographing area) by a different photographing condition.

A seek-area setting-out means to divide at least one picture of an inputted picture into two or more region divisions, and to provide a seek area showing the feature of a picture of the focus in said each region division.

The 1st position information extraction means that relates characteristic position information on a photographic subject within said composition to coordinates over each region division of said division picture, and extracts it from a seek area of each of said focus based on characteristic quantity of said picture.

The 2nd position information extraction means extracted as position information which related a point acquired by searching for a point corresponding to said characteristic position information to each of said inputted images other than said divided picture of corresponding to coordinates over the picture.

A corrected parameter detection means to detect a corrected parameter based on a gap between each coordinates of said extracted characteristic position information and position information on said point of corresponding, and a picture compensation means which amends a picture based on a detected corrected parameter so that an object position of each picture may be in agreement.

[0015]One in two or more inputted pictures is chosen, this picture is divided into two or more fields, and an image processing device of the above composition sets up the focus from characteristic quantity of that region division, and memorizes a coordinates position of that

focus. As opposed to each another inputted image which was not chosen based on coordinates of the focus, searching for a point of corresponding and extracting a coordinates position of the corresponding points -- physical relationship (the amount of parallel translation.) between [coordinates and corresponding-points coordinates of the focus to] pictures Angle of rotation is computed, and after performing alignment amendment so that a picture of one side or both may be amended and a photographic subject may agree, dynamic-range-compression processing, depth-of-field expanding processing, etc. are performed.

[0016]

[Embodiment of the Invention]Hereafter, with reference to drawings, the embodiment of this invention is described in detail. The example of composition of the image processing device as a 1st embodiment by this invention is shown and explained to drawing 1.

[0017]In this embodiment, the picture which is photoed with the picture and film-based camera which were photoed with the digital camera which is not illustrated, and was photographed with the scanner etc. is recorded on storages, such as a hard disk, a portable floppy disk, and a memory card.

[0018]The image data regenerating section 31 which this embodiment reads the picture currently recorded on said hard disk, the floppy disk, the memory card, etc. if it divides roughly, and processes extension etc., The picture amendment part 30 which performs interpolating calculation and amends the physical relationship of the photographic subject of a picture by the method of mentioning later from the image data regenerating section 31 to an inputted image, It comprises the image synthesis section 39 which performs dynamic range expansion mentioned above and depth-of-field expansion to the picture by which physical relationship was amended by said picture amendment part 30.

[0019]The frame memory 32 said picture amendment part 30 remembers temporarily the image data to which elongation processing was performed by the image data regenerating section 31 to be, The focus set part 33 which sets up two or more focus (coordinates) later mentioned to one selected picture, The corresponding-point-searching part 35 which searches for the point of corresponding in another picture from the image data of the focus circumference started as the focus position memory 34 which memorizes the focus coordinates, and focus coordinates and a template, The corresponding-points position memory 36 which memorizes the acquired corresponding-points coordinates position, and the corrected parameter calculation part 37 which computes the physical relationship (the amount of parallel translation, angle of rotation) between the pictures of two sheets from focus coordinates and corresponding-points coordinates, It comprises the interpolating calculation part 38 which amends the picture of one side or both and is outputted to the image synthesis section 39 from the inputted physical relationship.

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TECHNICAL FIELD

[Field of the Invention]This invention relates to the image processing device which performs alignment amendment so that a photographic subject may be in agreement, when the device which combines the picture beyond the dynamic range and depth of field of the input device is started from two or more pictures which photoed the same photographic subject by a different photographing condition, especially each picture is piled up.

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PRIOR ART

[Description of the Prior Art]By combining two or more pictures which generally photoed the same photographic subject by different exposure. The image processing technique which creates the picture which has a dynamic range of the range more than the peculiar dynamic range of image sensors, such as CCD (Charge Coupled Device). (For example, JP,63-232591,A) Two or more pictures which photoed the same photographic subject in a different focal position are combined, and there is an image processing technique (JP,1-309478,A) which creates the picture which has depth of field deeper than the depth of field of an input optical system.
[0003]Art which creates this wide dynamic range image is realized with the composition shown in drawing 12 (a). Picture illustrated. A and B are the pictures which changed and photoed exposure, respectively.
The relation between the incident light quantity which enters into an image sensor, and the signal value of the picture acquired with image input apparatus becomes like "[A] long time exposure" of drawing 12 (b), and "[B] short-time exposure."

[0004]In the adding machine 11, the pixel value of the pictures A and B is added and the value shown in drawing 12 (b) as a "[C] summed signal" is memorized by the frame memory 12. The shape of this "[C] Summed signal" is determined by the exposure ratio of the picture of two sheets. In the linear transform part 13, the incident light quantity I is presumed from the summed signal value S, and it changes into the luminance-signal value Y from the signal value of R, B, and G each color in the matrix circuit 15.
[0005]And in the luminosity compression zone 16, a luminance value is compressed and compressed luminance-signal value Y' is outputted so that presumed incident light quantity may be settled in a fixed gradation number. R, G, and B which Y'/Y is calculated in the divider 17 and are the outputs of the linear transform part 16 -- it is multiplied with each signal and

multiplier 18, and a result is stored in the frame memory 19.

[0006]Since this image processing technique uses two or more image data, it can acquire the picture which has good color reproduction, and few noises compared with the case where tone curve processing of the short-time exposure picture is only carried out.

[0007]The image processing technique which creates the picture which has depth of field deeper than the depth of field of the input optical system mentioned above is realized with the composition shown, for example in drawing 13. First, weighting addition is carried out with the adding machine 21, and the picture which changed the focal position and was photoed is memorized by the frame memory 22. If weighting addition of the picture which changed the focal position is carried out according to a focal position, it is known that the Japanese quince of the whole picture will be equalized.

[0008]So, in the recovery filter setting circuit 25, the recovery filter of the Japanese quince in the picture after addition is determined, and it outputs to the matrix arithmetic circuit 23. Here, since it is not a portion in connection with the essence of this invention, the preparation method of a Japanese quince recovery filter is omitted. In the matrix arithmetic circuit 23, a recovery filter is made to act on an addition picture, and a result is stored in the frame memory 24. As a result, the picture stored in the frame memory 24 is a picture whose depth of field is deeper than an imaging optical system.

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EFFECT OF THE INVENTION

[Effect of the Invention]As explained in full detail above, according to this invention, the image processing device amended with the value of the parameter which detects the physical relationship between several pictures from which photographing conditions, such as exposure and a focal position, differ, and shows the detected physical relationship so that a picture may lap correctly can be provided.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]Once the image processing technique mentioned above adds or adds [weighting] the photoed picture for every pixel, it performs dynamic-range-compression processing and a series of processings of recovery. Therefore, when the picture which is the target of addition had caused the position gap mutually, it shifted, when it added and an exact result was not obtained.
[0010]Therefore, in the case of dynamic range expanding processing, . Since nondestructive readout is possible, use the apparatus using the CMD (Charge Modurated Device) element which does not cause a position gap while photoing a picture by two or more exposure theoretically. In depth-of-field expanding processing, as it said that a firm stage was required, the expensive business-use device was needed. When changing and photoing a focal position, change of the delicate magnification for every focal position also influences.
[0011]With a digital camera, a scanner, and a tripod which a general user uses, what [a thing] that cannot expect accuracy simple occupies most to it compared with commercial equipment. Therefore, the advantage of the image processing technique mentioned above was not fully able to be employed efficiently.
[0012]For example, when a camera moves when carrying and photoing a digital camera to a tripod, and pushing a shutter, or capturing the image photoed with the film-based camera by a film scanner, it is shifting mutually by the method of insertion of a film etc.
[0013]Then, an object of this invention is to provide the image processing device amended with the value of the parameter which detects the physical relationship between several pictures from which photographing conditions, such as exposure and a focal position, differ, and shows the detected physical relationship so that a picture may lap correctly.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure showing the example of composition of the image processing device as a 1st embodiment.
[Drawing 2]It is a figure showing the example of composition of the focus set part shown in drawing 1.
[Drawing 3]The figure and drawing 3 (b) which drawing 3 (a) shows the region division where plurality divided the picture, and the focus seek area set as each region division are a figure for explaining the focus.
[Drawing 4]It is a figure showing the example of composition of the corresponding-point-searching part shown in drawing 1.
[Drawing 5]The figure in which drawing 5 (a) shows the example of composition of the image processing device as a 2nd embodiment, and drawing 5 (b) are the figures showing the example of composition of a territorial extension part.
[Drawing 6]Drawing 6 (a) is a figure in which the figure showing an example of the appointed field displayed on the picture and drawing 6 (b) show the focused position displayed on the picture.
[Drawing 7]It is a figure showing the example of composition of the image processing device as a 3rd embodiment.
[Drawing 8]It is a figure showing the example of composition of the territorial extension part used for the image processing device as a 4th embodiment.
[Drawing 9]Drawing 9 (a) is a figure for a figure for the figure and drawing 9 (b) in which the inputted image divided into two or more region divisions is shown to explain specification of the focus set area by scan, and drawing 9 (c) to explain specification of the focus set area by extension.
[Drawing 10]It is a figure for explaining specifying the rectangle extended from the designated

point as a focus set area.

[Drawing 11]It is a figure showing the example of composition of the image processing device as a 5th embodiment.

[Drawing 12]It is a figure showing the example of composition for creating the conventional wide dynamic range image.

[Drawing 13]It is a figure showing the example of composition for creating the picture which has the conventional deep depth of field.

[Description of Notations]

30 -- Picture amendment part

31 -- Image data regenerating section

32 -- Frame memory

33 -- Focus set part

34 -- Focus position memory

35 -- Corresponding-point-searching part

36 -- Corresponding-points position memory

37 -- Corrected parameter calculation part

38 -- Interpolating calculation part

39 -- Image synthesis section

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MEANS

[Means for Solving the Problem]An image processing device whose this invention is characterized by that an image processing device comprises the following and which performs alignment processing between two or more pictures which photoed to achieve the above objects almost same composition (photographing area) by a different photographing condition.
A seek-area setting-out means to divide at least one picture of an inputted picture into two or more region divisions, and to provide a seek area showing the feature of a picture of the focus in said each region division.
The 1st position information extraction means that relates characteristic position information on a photographic subject within said composition to coordinates over each region division of said division picture, and extracts it from a seek area of each of said focus based on characteristic quantity of said picture.
The 2nd position information extraction means extracted as position information which related a point acquired by searching for a point corresponding to said characteristic position information to each of said inputted images other than said divided picture of corresponding to coordinates over the picture.
A corrected parameter detection means to detect a corrected parameter based on a gap between each coordinates of said extracted characteristic position information and position information on said point of corresponding, and a picture compensation means which amends a picture based on a detected corrected parameter so that an object position of each picture may be in agreement.

[0015]One in two or more inputted pictures is chosen, this picture is divided into two or more fields, and an image processing device of the above composition sets up the focus from characteristic quantity of that region division, and memorizes a coordinates position of that focus. As opposed to each another inputted image which was not chosen based on

coordinates of the focus, searching for a point of corresponding and extracting a coordinates position of the corresponding points -- physical relationship (the amount of parallel translation.) between [coordinates and corresponding-points coordinates of the focus to] pictures Angle of rotation is computed, and after performing alignment amendment so that a picture of one side or both may be amended and a photographic subject may agree, dynamic-range-compression processing, depth-of-field expanding processing, etc. are performed.

[0016]

[Embodiment of the Invention]Hereafter, with reference to drawings, the embodiment of this invention is described in detail. The example of composition of the image processing device as a 1st embodiment by this invention is shown and explained to drawing 1.

[0017]In this embodiment, the picture which is photoed with the picture and film-based camera which were photoed with the digital camera which is not illustrated, and was photographed with the scanner etc. is recorded on storages, such as a hard disk, a portable floppy disk, and a memory card.

[0018]The image data regenerating section 31 which this embodiment reads the picture currently recorded on said hard disk, the floppy disk, the memory card, etc. if it divides roughly, and processes extension etc., The picture amendment part 30 which performs interpolating calculation and amends the physical relationship of the photographic subject of a picture by the method of mentioning later from the image data regenerating section 31 to an inputted image, It comprises the image synthesis section 39 which performs dynamic range expansion mentioned above and depth-of-field expansion to the picture by which physical relationship was amended by said picture amendment part 30.

[0019]The frame memory 32 said picture amendment part 30 remembers temporarily the image data to which elongation processing was performed by the image data regenerating section 31 to be, The focus set part 33 which sets up two or more focus (coordinates) later mentioned to one selected picture, The corresponding-point-searching part 35 which searches for the point of corresponding in another picture from the image data of the focus circumference started as the focus position memory 34 which memorizes the focus coordinates, and focus coordinates and a template, The corresponding-points position memory 36 which memorizes the acquired corresponding-points coordinates position, and the corrected parameter calculation part 37 which computes the physical relationship (the amount of parallel translation, angle of rotation) between the pictures of two sheets from focus coordinates and corresponding-points coordinates, It comprises the interpolating calculation part 38 which amends the picture of one side or both and is outputted to the image synthesis section 39 from the inputted physical relationship.

[0020]In the image processing method of this embodiment constituted in this way, processing of extension etc. is performed by the image data regenerating section 31, and the picture read

from said hard disk, the memory card, etc. is memorized by the frame memory 32 of the picture amendment part 30. Here, the data outputted from the image data regenerating section 31 shall contain not only the pixel value of a picture but the additional data of image size, a color number, a color map, etc.

[0021]Next, one in an inputted image is chosen (here, it is considered as the picture A), and it is inputted into the focus set part 33. In this focus set part 33, two or more focus (coordinates) is set up by the method of mentioning later, and focus coordinates are inputted into the focus position memory 34. The set-up focus coordinates are inputted also into the corresponding-point-searching part 35, and simultaneously, the image data of the focus circumference is started as a template, and is inputted into the corresponding-point-searching part 35.

[0022]It is among a picture other than the picture inputted into the focus set part 33 (here the picture B), and the corresponding-point-searching part 35 is searched for the point corresponding to the inputted template. The method of searching for corresponding points is mentioned later.

[0023]As a result, a corresponding-points coordinates position is outputted to the corresponding-points position memory 36. In the corrected parameter calculation part 37, the focus coordinates of the focus position memory 34 and the corresponding-points coordinates of the corresponding-points position memory 36 are read, and the physical relationship (the amount of parallel translation, angle of rotation) between the pictures of two sheets is computed. And in the interpolating calculation part 38, from the inputted physical relationship, the picture of one side or both is amended and it outputs to the image synthesis section 39.

[0024]Although the dynamic range expanding processing and depth-of-field expanding processing which were mentioned above are performed in this image synthesis section 39, since the target picture is a picture to which position ****** was carried out in the picture amendment part 30 of the preceding paragraph, the picture naturally piled up correctly is acquired as a resulting image.

[0025]The composition of said focus set part 33 is shown and explained to drawing 2. At this focus set part 33, although two or more feature point positions are determined, when many focus concentrates on a part of picture, the error of position ****** may become large in the other portion. So, in the region dividing part 41, in order to make it the focus suitably scattered in a picture, a picture is divided into two or more fields, and a focus seek area is further set as the inside. Here, the example which divided the whole uniformly is shown in drawing 3 (a).

[0026]The small region which serves as a candidate of a template all over this field is moved, and the position from which characteristic quantity serves as the maximum is outputted as one of the focus. However, since processing time will start dramatically if it searches for the whole, it is desirable to set up a focus seek area smaller than the field divided like drawing 3 (a). The size of this focus seek area is beforehand decided on the basis of image size, for example like

5% of image size. Or it does not matter on the basis of the size of the divided small region.
[0027]Next, in the template spotting part 42, the template candidate position in a focus seek area is determined, and the image data in a template candidate is started by the template extraction part 43 based on the position. At this time, a template candidate's position is moved in order within the feature seek area in the template spotting part 42.
[0028]Since a template candidate's characteristic quantity change near in position may not be so large, in such a case, it is not that of ****** the whole pixel, it can also shift a template candidate's position at intervals of several pixels, and can reduce computational complexity as a result.
[0029]In the characteristic quantity calculation part 44, a template candidate's characteristic quantity is calculated and the template position from which characteristic quantity serves as the maximum by the characteristic quantity judgment part 45 is determined. In the template extraction part 46, the data of the position circumference in which characteristic quantity became the maximum is extracted as a template. As for this template extraction part 46, the template extraction part 43 may serve as that role. As this characteristic quantity, pixel value distribution as shown, for example in (1) type can be used.
[0030]
[Equation 1]

$$T = \sum_i |a_i - A| \qquad (1)$$

Here, ai is a pixel value, A is the pixel value average in a template candidate, and peace is taken to the whole inside of a template candidate. Although a concrete formula does not mention, they are the secondary pixel value distribution and a value also with an edge detection result preferred as characteristic quantity. At this time, said value T is a following formula, [0031]
[Equation 2]

$$T < T_{th} \qquad (2)$$

** -- like, when smaller than a certain default value Tth, it does not adopt noting that it is unreliable. For example, although the accuracy of matching which change of a pixel value generally mentions later in a small portion falls like the portion of the empty in drawing 3 (b), by the method of this invention, the focus is not set to a focus candidate position with the value T like (2) types, but the accuracy reduction of a physical relationship parameter can be prevented.
[0032]Drawing 4 is a figure explaining the composition of the corresponding-point-searching part 35. In the search area set part 51, the position and size of a field which search for corresponding points are set up on the basis of the focus coordinates read from the focus set

part 33. In the correlation operation part 52, based on the information in the search area set up by the search area set part 51, The image data of the circumference of a corresponding-points candidate position is started from the image data in the frame memory 32b so that it may have the same size as the template inputted from the focus set part 33, and a correlation value with the template data inputted from the focus set part 33 is calculated.

[0033]In the correlation value judgment part 53, a template and a position with the highest correlation which were extracted by the template extraction part 46 are judged, and it outputs to the corresponding-points position memory 36 by making a result into a corresponding-points position.

[0034]Although a corresponding-points candidate generally moves for every pixel at this time and a correlation value is calculated, in order to detect a corresponding-points position in accuracy below a pixel, with reference to the surrounding correlation value, interpolation may determine a corresponding-points position. As the correlation value, an absolute value sum of difference shown in the following (3) types, cross correlation shown in (4) types, normalization cross correlation shown in (5) types, etc. can be used.

[0035]

[Equation 3]

$$E = \sum_i |a_i - b_i| \qquad (3)$$

$$E = \sum_i (a_i - A) \cdot (b_i - B) \qquad (4)$$

$$E = \frac{\sum_i (a_i - A) \cdot (b_i - B)}{\sigma_A \cdot \sigma_B} \qquad (5)$$

Here, bi and B are the pixel values and averages in the small region where it moves in the search area of the picture B, $sigma_A$ and $sigma_B$ are the standard deviation of template data, and $sigma_A^2$ and $sigma_B^2$ serve as the variance.

[0036]If it calculates only about a certain representative color when calculating the aforementioned (2) - (4) type, it can process at high speed. If the correlation value of R, G, and B each color is added and it searches for corresponding points, it will become possible to perform corresponding-points search to high degree of accuracy more.

[0037]And in the corrected parameter calculation part 37, physical relationship between the pictures A and B is determined from focus coordinate data and corresponding-points coordinate data. Parameters for which it asks are costheta of (6) types, sintheta, sx, sy, and M.

[0038]

[Equation 4]

$$\begin{pmatrix} X \\ Y \end{pmatrix} = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \cdot \begin{pmatrix} M \cdot x \\ M \cdot y \end{pmatrix} + \begin{pmatrix} S_X \\ S_Y \end{pmatrix} \quad (6)$$

Here, a feature point position, and (X, Y) show a corresponding-points position, and M is [(x y)] equivalent to the relative magnification between pictures. Since two or more data is stored in said focus position memory 34 and the corresponding-points position memory 36, if it asks for a parameter in least square, it will become like (7) types.

[0039]

[Equation 5]

$$A_C = M \cdot \cos\theta = \left(\overline{xX} + \overline{yY} - \overline{x}\,\overline{X} - \overline{y}\,\overline{Y}\right) / \left(\sigma_x^2 - \sigma_y^2\right)$$

$$A_S = M \cdot \sin\theta = \left(\overline{xY} - \overline{yX} + \overline{y}\,\overline{X} - \overline{x}\,\overline{Y}\right) / \left(\sigma_x^2 - \sigma_y^2\right)$$

$$S_X = \overline{X} - M \cdot (\overline{x}\cos\theta - \overline{y}\sin\theta)$$

$$S_Y = \overline{Y} - M \cdot (\overline{x}\sin\theta + \overline{y}\cos\theta)$$

$$\overline{x} = \frac{1}{N} \cdot \sum_i^N x_i,\ \overline{y} = \frac{1}{N} \cdot \sum_i^N y_i,\ \overline{X} = \frac{1}{N} \cdot \sum_i^N X_i,\ \overline{Y} = \frac{1}{N} \cdot \sum_i^N Y_i$$

$$\overline{xX} = \frac{1}{N} \cdot \sum_i^N x_i \cdot X_i,\ \overline{yY} = \frac{1}{N} \cdot \sum_i^N y_i \cdot Y_i, \quad (7)$$

$$\overline{xY} = \frac{1}{N} \cdot \sum_i^N x_i \cdot Y_i,\ \overline{yX} = \frac{1}{N} \cdot \sum_i^N X_i \cdot y_i$$

It is here and N is the number of the focus. (8) From a formula, M, costheta, and sintheta are determined like (9) types.

[0040]

[Equation 6]

$$A_C^2 + A_S^2 = M^2 \quad (8)$$

$$M = \sqrt{A_C^2 + A_S^2},\ \cos\theta = \frac{A_C}{M},\ \sin\theta = \frac{A_S}{M} \quad (9)$$

[0041]When it can be assumed that there is no magnification change in an object image since original costheta and sintheta have a relation of $\cos^2$theta+$\sin^2$ theta= 1, by the result of (9) types. It is better to amend costheta and sintheta like (11) types, when it is referred to as M= 1.0 and becomes a relation like (10) types. sx and sy are calculated from amended costheta and sintheta.

[0042]

[Equation 7]

$$\cos^2\theta + \sin^2\theta = R^2 \quad (R \neq 1.0) \tag{10}$$

$$\cos\theta \rightarrow \frac{1}{R}\cdot\cos\theta, \quad \sin\theta \rightarrow \frac{1}{R}\cdot\sin\theta \tag{11}$$

[0043]Although (6) - (9) type mentioned above made the arbitrary starting points the center of rotation of the picture, you may think that setting out and the searched center of gravity of the focus and each corresponding-points position are in agreement. The centroid position (here (/x, /y), / is used as a sign meaning an average.) of the focus as it is in the image information of each formula, in each formula, this average is expressed as an exaggerated bar -- the centroid position of corresponding points -- (/X and /Y) -- it is come out and given -- costheta, sintheta, sx, and sy are given by (12) and (13) formulas, respectively.

[0044]

[Equation 8]

$$\cos\theta = \left(\overline{xX} + \overline{yY}\right) / \left(\overline{x^2} + \overline{y^2}\right)$$

$$\sin\theta = \left(\overline{xY} - \overline{yX}\right) / \left(\overline{x^2} + \overline{y^2}\right) \tag{12}$$

$$\overline{x^2} = \frac{1}{N}\cdot\sum_i x_i^2, \quad \overline{y^2} = \frac{1}{N}\cdot\sum_i y_i^2$$

$$s_x = \bar{X} - \bar{x}$$

$$s_y = \bar{Y} - \bar{y} \tag{13}$$

[0045]As explained above, a general user can also do the maximum use of the effect of dynamic range expanding processing and depth-of-field expanding processing, without using expensive business-use equipment, in order for this embodiment to extract two or more focus out of a picture and to perform position ****** automatically. However, when the distortion aberration has arisen in the object image of processing, it is necessary to amend beforehand by arbitrary techniques.

[0046]Next, a 2nd embodiment by this invention is described. This embodiment differs in the composition inside the focus set part 33 as compared with a 1st embodiment mentioned above.

[0047]Drawing 5 (a) is a figure showing the notional composition of the focus set part 33. This composition differs in that the territorial extension part 81 is added compared with the composition shown in drawing 1. Drawing 5 (b) is a figure showing the example of composition of the territorial extension part 81. In this territorial extension part 81, two or more fields to

observe are directed in the field directions part 83 to the inputted image data. The focus is set as the inside of the field specified here by the above-mentioned method.

[0048]In this display control part 84, a specified field (data from the region memory 85 mentioned later) is overlaid on inputted image data, for example, as shown in drawing 6 (a) and (b), and that data is displayed on the indicator 82. A display of attachment in PC may be sufficient as this indicator 82, and it may provide a thing for exclusive use independently. You may point to the field directions part 83 with a mouse of attachment in PC, and it may be provided independently. Although said display control part 84 was explained as a part of composition of the territorial extension part 81, composition that a function of operating systems (OS), such as a personal computer, is used may be sufficient as it.

[0049]In the field directions part 83, an observation region may be specified with coordinates in a picture. And the region memory part 85 memorizes a position and size of a field directed in the field directions part 83, and outputs it to the region dividing part 41. In the region dividing part 41, the focus is set up based on region information from the region memory part 85 by a method described above inside a directed field.

[0050]Since raise alignment accuracy of a portion which a user wants to observe, and things are made by composition of this embodiment and focus search is not needed in a portion which is not so required, computation time can be shortened.

[0051]When a photographic subject which moves is included in a taken image, if human being, a vehicle, etc. use a picture of a portion which moved for calculation, an error will produce them in alignment of the whole picture, but it can avoid using data of such a portion in composition of this example gestalt.

[0052]It is possible to point to a specific field among two or more fields to which it pointed in the field directions part 83, and only for the inside to improve alignment accuracy of the specific region further by setting up many focus from other fields.

[0053]in the case of dynamic range expansion art, compared with a case where a picture is chosen and performed at random, accuracy can be improved by performing the above-mentioned operation in order of exposure value between pictures which align in the case of depth-of-field expansion art, and adjoin it in a picture in order of a focal position.

[0054]Drawing 7 is a figure showing a 3rd embodiment of this invention. Composition of the picture amendment part 30 shown in drawing 7 is added to composition of the picture amendment part 30 shown in drawing 1, and the indicator 82, the display control part 84, and the focus directions part 90 are contained. Two or more feature point positions are set up by an above-mentioned method, and are memorized by the focus memory 34.

[0055]Focus coordinates memorized by this focus memory 34 are sent to the focus directions part 90, and that position is overlaid by the indicator 82 on an object image through the display control part 84 (for example, drawing 3 (b)).

If the focus is set up on a photographic subject (movable matter object) in which human being, a vehicle, etc. move at this time, it will become a cause of an error of a correction factor calculated by (6) - (10) formula. So, in the focus directions part 90, when a movable matter object is included, the object is detected, and the focus set up on a movable matter object is excepted from data used for calculation, and deletes data from the focus memory 34.

[0056]A user judges displayed data and this operation may be made to ** data excepted from the focus directions part 90. Data of the focus memory 34 and the corresponding-points memory 36 is simultaneously displayed on the indicator 82 after corresponding point searching, and when a user judges that correspondence cannot be taken, you may make to except the data into business which can be directed by the focus directions part 90.

[0057]Next, a 4th embodiment by this invention is described with reference to drawing 8. This 4th embodiment is changed into composition as shows drawing 8 the territorial extension part 81 of drawing 5.

[0058]The territorial extension part 81 shown in drawing 8 comprises the field directions part 83, the region memory 85, and the state judging part 101. According to this embodiment, a range specified as a focus set area based on statistical and physical character of a picture is determined.

[0059]First, the whole picture is divided into a size which was able to be beforehand decided like drawing 9 (a). Let size divided at this time be a larger range than a template started by a focus set part.

[0060]It is judged whether each divided portion is sent to the state judging part 101, and is specified as a focus set area. In the state judging part 101, when inputted image data is scanned and a saturated pixel is over a fixed rate, it is judged that it is not suitable as a focus set area.

[0061]In the state judging part 101, when it is over a threshold with average value of input data, you may judge that it is not suitable as a focus set area. The field directions part 83 outputs image data of a divided field to the state judging part 101 in order like drawing 9 (b), and when it is judged that it is suitable as a focus set area, it records including the range on the region memory 85.

[0062]In explanation mentioned above, although judged for every region division, you may make it the whole range currently recorded on the region memory 85 as image data outputted to a state judging part. A region division with a user is specified and it may be made to contain to the focus appointed field in an order from a field of the circumference of it in the field directions part 83, as shown in drawing 9 (c).

[0063]One with a user is specified in the field directions part 83, a rectangle extended to the surroundings of it is assumed, and it may be made to judge the image data by the state judging part 101, as shown in drawing 10.

[0064]Although a saturated pixel value was used for a decision criterion, in the state judging part 101, orthogonal transformation, such as discrete Fourier transform of an inputted picture and a discrete cosine transform, may be judged by power of a high frequency component when it gives a picture, and an ingredient of wavelet transform.
[0065]In the state judging part 101, contrast of inputted data and a difference of the pixel value maximum and the minimum may be used for judgment. Next, a 5th embodiment by this invention is described with reference to drawing 11.
[0066]This embodiment is an example from which a picture of three or more sheets is a processing object. Here, the same reference mark is given to a composition part equivalent to drawing 1 mentioned above while illustrating, and the explanation is omitted to it.
[0067]In this embodiment, image data reproduced by the image data regenerating section 31 is inputted into one of the frame memories 32a and 32b by the image switching section 111 which carries out switch operation with directions of the picture selection instructing part 114. This picture selection instructing part 114 chooses processing time of a device, etc. at its own discretion so that the inputted same photographic subject can process two or more photoed pictures sequentially, and it controls the picture changeover section 111 to be inputted by turns to two frame memories.
[0068]The focus and corresponding points are detected by a method mentioned above from a picture stored in said frame memories 32a and 32b, and physical relationship (the amount of parallel translation, angle of rotation, and relative magnification) between pictures is computed by the corrected parameter calculation part 37. A parameter computed by the corrected parameter calculation part 37 is memorized by the corrected parameter storage parts store 113 with picture ID and image comparison ID.
[0069]Said corrected parameter converter 112 reads data memorized by the corrected parameter storage parts store 113, and changes it into the amount of parallel translation and angle of rotation which saw each data from a picture used as a standard of amendment specified beforehand. Then, in the interpolating calculation part 38, the corrected parameter converter 112 amends a picture according to a parameter seen from a correction reference picture.
[0070]Amendment in data conversion and the interpolating calculation part 38 in the corrected parameter converter 112 may be performed for every operation of the image switching section 111, and after computing physical relationship relative about all object images, a picture may be anew read into the frame memory 32 here.
[0071]Although it was considered as the two frame memories 32 and explained that an inputted image was changed by the signal switching part 111 by this embodiment, a number of frame memories which can store all object images may be prepared.
[0072]Although an above embodiment was described, the following inventions are also

included in this specification.
(1) A picture is divided into two or more region divisions in several pictures from which a photographing condition differs, A focus seek area the same as each region division or small is provided all over said region division, Based on a statistics value of a picture, characteristic position information on a photographic subject is extracted from each focus seek area, It searches for a point of corresponding in a different picture from a picture which extracted characteristic position information on a photographic subject among said two or more pictures, An image processing device which detects corrected parameters (the rotation, movement, magnification change, etc. between pictures), and amends a picture based on the rotation, movement, and magnification change between pictures as said corrected parameter from said characteristic position information and corresponding position information on a point.
[0073]This invention corresponds to a 1st embodiment. thereby, when you pile up two or more pictures, a more exact picture should pile up -- it can carry out now.
(2) In an image processing device given in the aforementioned (1) paragraph, amend after changing a parameter so that the rotation, movement, and magnification change seen from a specific reference image may be expressed when amending a picture based on said rotation, movement, and magnification change.
[0074]This invention corresponds to a 5th embodiment. Thereby, when piling up two or more pictures, suitable arbitrary corrected parameters can be set up to each picture, and a more exact picture according to a photography person's intention can be piled up.
(3) An image processing device given in 1 restricting a field to divide to a part of picture about said two or more region divisions.
[0075]This invention corresponds to a 2nd embodiment. By this, when piling up two or more pictures, speed of image processing improves, and a suitable field can be set up to each picture and a more exact picture according to a photography person's intention can be piled up.
(4) Don't use for detection of the rotation, movement, and magnification change between pictures position information set up on a photographic subject which a position is moving among two or more pictures among characteristic position information on a photographic subject based on a statistics value of said picture in an image processing device given in the aforementioned (1) paragraph or (3) paragraphs.
[0076]This invention corresponds to a 3rd embodiment. Since a field where a movable matter object exists is eliminated by this when piling up two or more pictures, a more exact picture can be piled up.
(5) A restricted space which restricts a field to divide to a part of picture in an image processing device given in the aforementioned (3) paragraph, It is characterized by a thing of a pixel whose high frequency component when orthogonal transformation was carried out was

saturated comparatively comparatively restricted on the basis of a value of a difference of average value of a pixel value, and the greatest and minimum pixel value, and either of the contrast.

[0077]This invention corresponds to a 4th embodiment. By this, when piling up two or more pictures, speed of image processing improves, and a suitable field can be automatically set up to each picture, and a more exact picture according to a photography person's intention can be piled up.

(6) Extend a restricted space focusing on a specific point in an image processing device of a statement in the aforementioned (5) paragraph.

[0078]This invention corresponds to a 4th embodiment. Since a suitable field is set up to each picture focusing on a specific point by this when piling up two or more pictures, a more exact picture can be piled up.

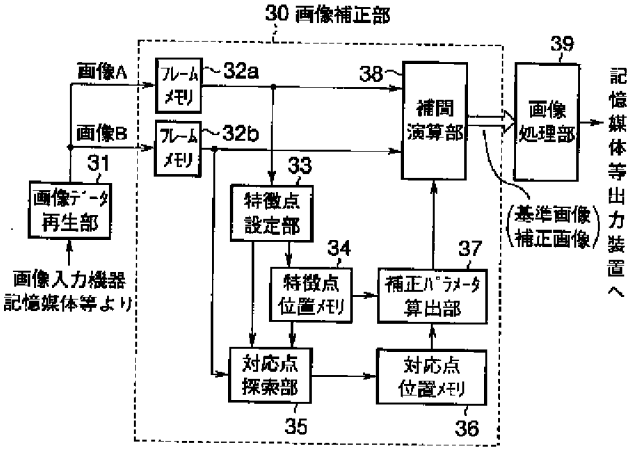
[Translation done.]

* NOTICES *

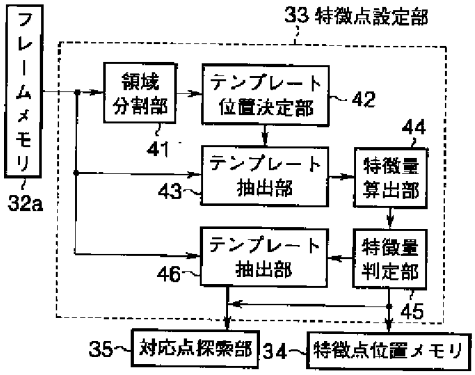
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

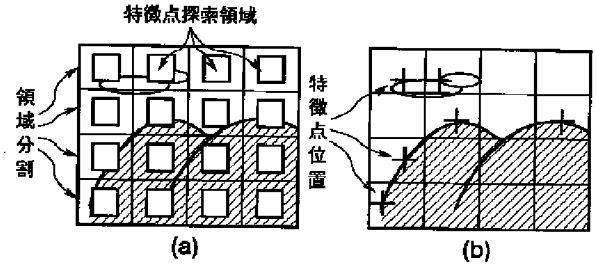
[Drawing 1]



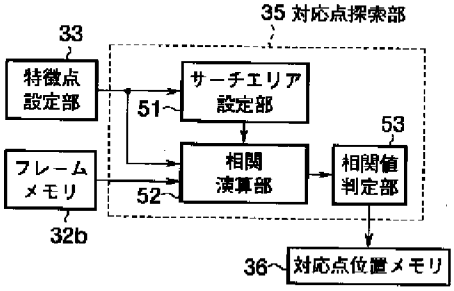
[Drawing 2]



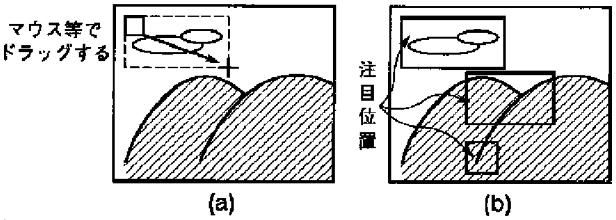
[Drawing 3]



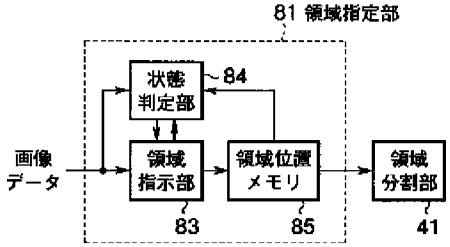
[Drawing 4]



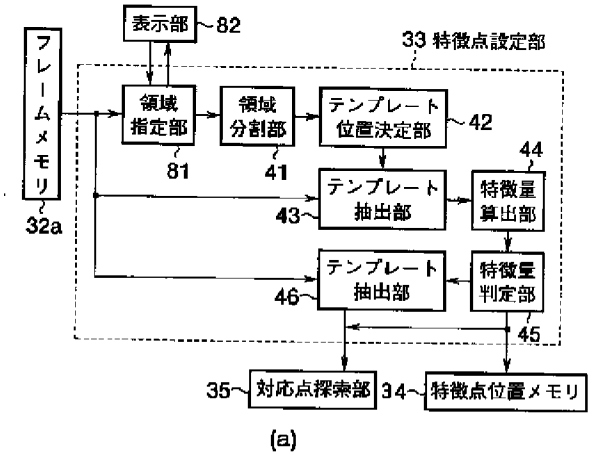
[Drawing 6]



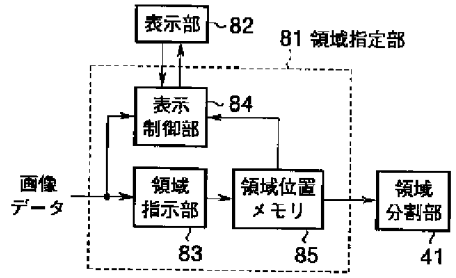
[Drawing 8]



[Drawing 5]

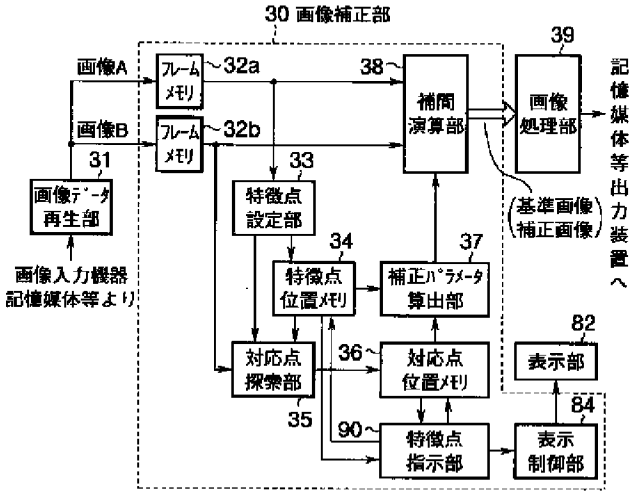


(a)

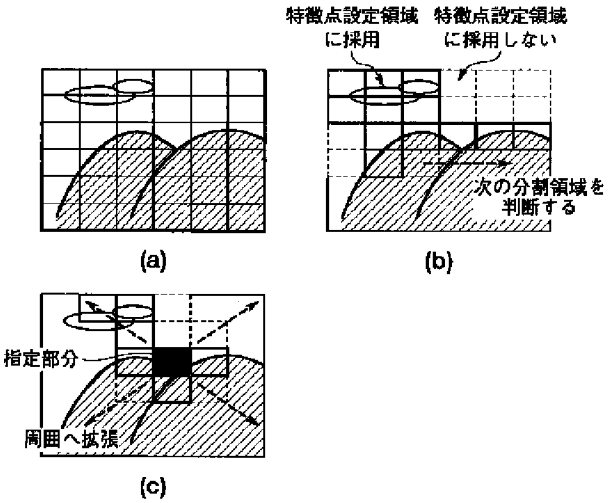


(b)

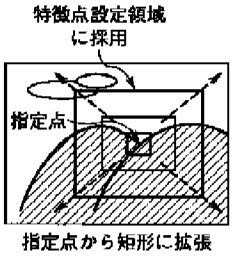
[Drawing 7]



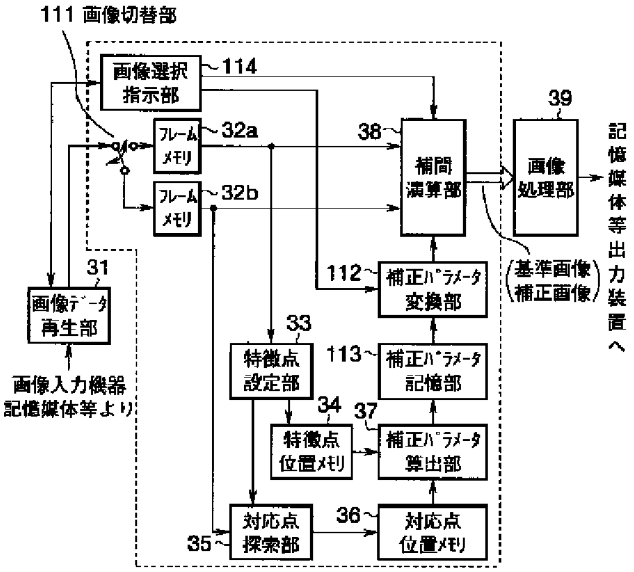
[Drawing 9]



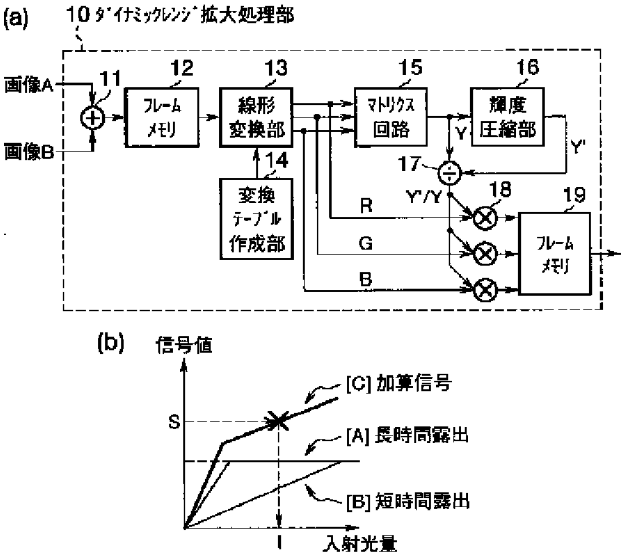
[Drawing 10]



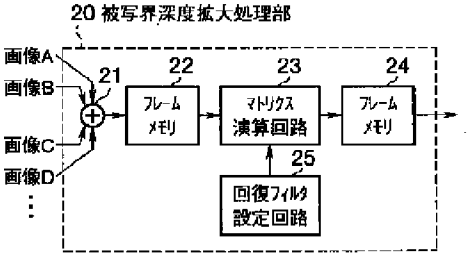
[Drawing 11]



[Drawing 12]



[Drawing 13]



[Translation done.]